

## Microbiological alkylation and volatilization of inorganic selenium immobilized by goethite, Se-LDH, and ferroselite

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Selenium under reducing cement-bearing near field conditions is preferentially precipitated in the oxoanionic form of selenite with the cement mineral hydrotalcite (Se-LDH), in the more reduced selenide form with iron as ferroselite,  $\text{FeSe}_2$ , or in the more oxidized form of selenate with the Fe-oxide goethite. Se sorbed by these solid phases is considered as of low mobility and thus of benefit for long-term stabilization of, e.g., the fission product  $^{79}\text{Se}$ . We will show, however, that sulfate-reducing bacteria (SRB) including the common *Desulfovibrio gigas* are capable to volatilize the Se from all these solid phases. We used a standardized nutrient broth for sulfate reducers and incubated with  $10 \text{ g L}^{-1}$  suspension under strictly anaerobic conditions. For sampling we gently purged the head space of the culture flasks with nitrogen into Tedlar bags. Volatile organic selenium (VOSe) species were measured by a cryotrapping cryofocussing gaschromatographic system with ICP-MS detection. Alkylated species found at the tens to hundreds  $\text{ng m}^{-3}$  level above the Se-LDH and goethite cultures were the common dimethyl selenide (DMSe) and dimethyl diselenide (DMDS<sub>e</sub>) but also ethylated forms (Figure 1). Species concentrations found during the  $\text{FeSe}_2$  incubation were by 1-2 orders of magnitude lower, but two more yet unknown compounds with peaks at retention times in between those of DMSe (150s) and DESe (300s) were found to occur within a few days (Figure 1). In conclusion, microbe mediated VOSe formation cannot be neglected but must be considered as a potential fission product mobilization pathway, which may lead to onsite accumulation of highly mobile  $^{79}\text{Se}$  through evapoconcentration.

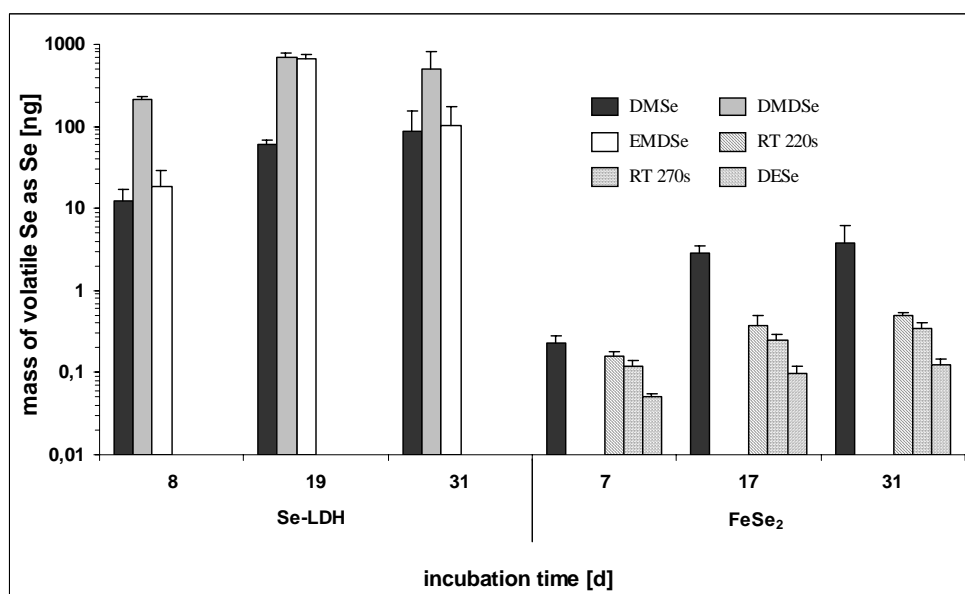


Figure 1: Time-dependent volatilization of alkylated selenium from two different inorganic selenium sources (error bars represent standard deviation,  $n = 3$ ).